# Single-leaf pinyon pine diseases assessment in southern Idaho and northern Utah

**Forest Health Protection, Boise Field Office**

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## Introduction

Single-leaf pinyon pine (*Pinus monophylla*), also known as singleleaf piñon, is a conifer tree species native to western North America and the world's only single-needle pine. In the United States, single-leaf pinyon pine can be found in the mountain ranges of the Great Basin: southern Idaho, western Utah, northwestern Arizona, most of Nevada, and eastern and central California (U.S. Forest Service 2015). Single-leaf pinyon pine commonly grows as tall as 46 feet in the wild and reach circumference of 19 inch in diameter (Bradshaw and Reveal 1943). It is pyramidal in shape, and the bark is irregularly scaly. Needles are around two inch long, gray-green to blue-green, and aromatic. It produces edible seeds that are valued for Native Americans for thousands of years (Lanner 1981) and several wildlife species including birds and small and large mammals species (Vander Wall 1997; Short and McCulloch 1977). At present, the pine nuts are still harvested and locally sold on village markets, alongside the highways, or used as treat in homes (Farjon 2013). Single-leaf pinyon pine has little commercial value due to its small size and lack of self-pruning, but the wood is primarily used for firewood and fencepost (Burns and Honkala 1990). Single-leaf pinyon pine is rarely seen in nurseries because it is difficult to germinate (Rose 2017). However, it is regionally used as ornamental tree on well-drained porous, gravelly soil gardens and xeriscaping. Single-leaf pinyon pine is also a desirable Christmas tree because of its blue-grey coloration, fragrance, and strong branches.

Several damaging agents affect the growth or survival of single-leaf pinyon pine. Insects of particular importance includes pinyon *Ips* beetles (*Ips confuses*), twig beetles (*Pytyophthorus* spp; *Pityogenes* spp.), and pinyon tip moth (*Dioryctria albovitella*) (Skelly and Christopherson 2003). Rogers (1993) considers the pinyon *Ips* beetle the most important insect mortality agent, causing the majority of pinyon pine mortality in the Intermountain West. Often the stressed larger and older trees are most susceptible to this beetle.

Single-leaf pinyon pine is also host of black stain root disease, caused by the fungal pathogen *Leptographium wageneri* var. wageneri (Sinclair and Lyon 2005; Diamandis et al. 1997). The disease spread by root contact and confined to the xylem on the root system and in the lower portion of the bole. Root feeding beetles and weevils may also act as vectors of this disease (Hessburg et al. 1995). Black stain root disease can cause tree mortality especially on young trees. Older trees decline more slowly from this disease and become more susceptible to bark beetle infestations (Eager 1999).

Black stain root disease occurs throughout the western United States (Sinclair and Lyon 2005; Hessburg et al. 1995). Skelly and Christopherson (2003) suggested that occurrence of this disease is not widespread on single-leaf pinyon pine. Wagner and Mielke (1961) identified small groups of single-leaf pinyon pine killed by this disease in the San Bernardino Mountains, California. Harrington and Cobb Jr. (1986) collected and identified strains of this pathogen from southern Sierra Nevada, California and south-eastern Nevada on single-leaf pinyon pine.

Pinyon pine dwarf mistletoe, *Arceuthobium divaricatum*, is a native parasitic flowering plant to western North America (Nickrent et al. 2004; Mathiasen et al. 2002; Hawksworth and Wiens 1996) (**Figure 1**). Pinyon pine dwarf mistletoe is restricted to pinyon pines. *Pinus monophylla* and *Pinus edulis* (two-needle pinyon) are considered the most common primary hosts (Mathiasen et al. 2016; Hawksworth et al. 2002). Hepting (1971) considers pinyon pine dwarf mistletoe the most important disease on single-leaf pinyon pine. Pinyon pine dwarf mistletoe damages the trees by swelling of infected branches, induces witches' broom growth forms, reduced growth rates, increase susceptibility to damaging agents, and tree mortality (Skelly and Christopherson 2003).


**Figure 1. Pinyon pine dwarf mistletoe on single-leaf pinyon pine (Photo: Brytten Steed; USDA Forest Service. Bugwood.org).**

Pinyon pine dwarf mistletoe has been reported to be abundant on pinyon pines throughout its range and causing extensive damage. Hreha and Weber (1979) found that eighty-seven percent of the observed pinyon pine mortality had evidence of dwarf mistletoe infection and reported host vigor of pinyon pine declined as degree of infection increased. Daugherty and Mathiasen (2003) suggested that increased pinyon pine mortality seems to be directly related with severe dwarf mistletoe infection. Hawkworth and Wiens (1996) suggested that the distribution of *A. divaricatum* is more common than those indicated by previous collections. Records indicates incidences of pinyon pine dwarf mistletoe in California, Nevada, Utah, Colorado, Arizona, New Mexico, Texas, United States, and Baja California Norte, Mexico (Mathiasen et al. 2002). Pinyon pine dwarf mistletoe has been reported occurring in Cassia County, Idaho by J.R. Weir in 1920 (unpublished manuscript) (Hawksworth and Wiens 1996). However, from southern Idaho its presence in the field has not been confirmed, nor has herbarium collections of *Arceuthobium divaricatum* been deposited.

Therefore, this survey was conducted to determine the presence of pinyon pine dwarf mistletoe and black stain root disease on single-leaf pinyon pine stands in southern Idaho and northern Utah, including the Minidoka Ranger District, Sawtooth National Forest. Information on the incidence and severity of

dwarf mistletoe infections is required by resource managers for making informed land management decisions.

## Materials and Methods

During 2016 and 2018, a combination of observation plots and reconnaissance surveys were conducted in pinyon pine forested areas in southern Idaho and northern Utah. Road systems were chosen before field work began, and adjustments were made in the field only when selected roads systems were closed or impassable.

The survey started at the edge of single-leaf pinyon pine areas along accessible forested roads or trails; this starting point was recorded using a Global Positioning System (GPS) portable unit. We then established an observation plot. Each observation plot measured 25 feet each side of the road or trail and contoured the road or trail for 150 feet. Observation plots were not monumented. Within each observation plot, we examined all single-leaf pinyon pines for sign or symptoms of pinyon pine dwarf mistletoe such as: witches' brooms, spindle-shaped swelling on branches, and yellow to light-green leafless aerial shoots on accessible branches. We also examined each tree for aboveground symptoms of black stain root disease which included dead trees, decreased height growth, crown discoloration (yellowing of needles), thin crown, exuding resin in the lower bole, and the production of distress cones on live trees. Presence or absence of these diseases were documented for each tree within the observational plot. Subsequent observation plots were established approximately every 0.2 mile along the selected forested road/trail segments.

Between observational plots, reconnaissance surveys were conducted by driving (or hiking) along the selected forested road / trail at low speed (at less than 10 mile per hour). Any suspect (symptomatic) host trees noted during the reconnaissance survey were further inspected and observations documented.

Start and end points of the surveyed forested road/trail segments were recorded. The number of established observation plots varied depending upon the length of the single-leaf pinyon pine forested area or the accessibility of the selected road or trail. We did not collect data on the following characters: a) forest composition (associated tree species), b) forest density, c) aspects, d) stand structure (age class), e) tree height, and f) diameter at breast height (DBH).

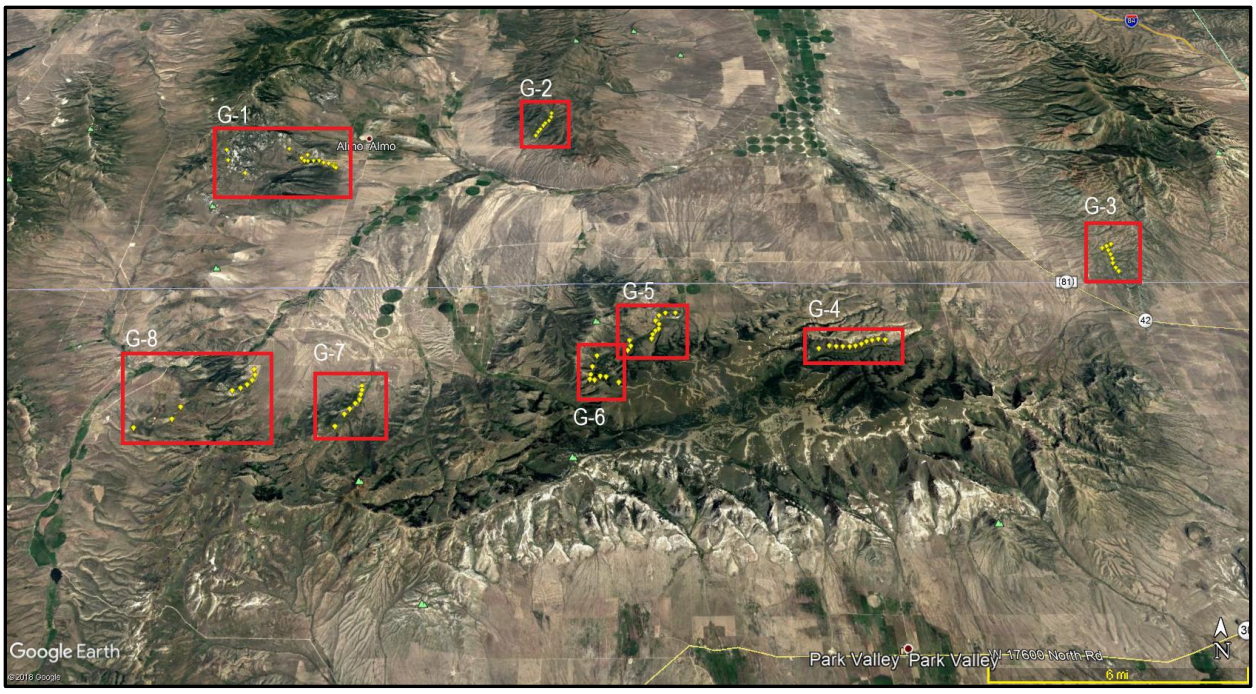


**Figure 2. A Google Earth image displaying a section of southern Idaho and northern Utah and the location of geospatial recorded observation plots (yellow dots). Eight segments of roads and trails were surveyed for the presence or absence of pinyon pine dwarf mistletoe and black stain root disease in single-leaf pinyon pine stands. Map symbols: G1=City of Rocks National Reserve, G2=Jim Sage Mountain range, G3=Black Pine Mountains range, G4=Clear Creek Rd. (FS 001), G5=One Mile Rd (FS 005), G6=Cabin Spring Rd. (FS 011), G7=Wild Cat Rd. (FS 003), and G8=Broad Hollow Rd. (FS 016).**

## Results and Discussion

A total of 86 observation plots were stablished during the 2016 and 2018. Of these, 29 were established within the City of Rocks National Reserve, 7 were south of the Jim Sage Mountain range, and 50 were within the Black Pine and Raft River Divisions, Minidoka Ranger District, Sawtooth National Forest. We closely examined more than 1,362 single-leaf pinyon pine and found no positive identification (presence) of pinyon pine dwarf mistletoe nor black stain root disease in the observational plots (**Table 1**).

Based on road accessibility, we reconnaissance surveyed a total of 8 segments of forested road and trails in southern Idaho and northern Utah, approximately 16.4 miles (**Figure 2, Table 1**). Of these, 4.8 miles in the City of Rocks National Reserve, including Smoky Mountain, Elephant Rock, Bread Loaves campgrounds, and Emery Pass picnic area. In the Jim Sage Mountain area, we surveyed a total of 1.6 miles of single-leaf pinyon pine forested areas and for the Black Pine and Raft River Divisions of the Minidoka Ranger District, a total of 10 miles of transects. Elevation range for surveyed single-leaf pinyon pine stands ranged from 5,390 feet near Black Pine Mountains in Idaho, to 7,801 feet in the Raft River Mountains of Utah.

**Table 1. Locations and results of single-leaf pinyon pine disease surveys in 2016 and 2018 from southern Idaho and northern Utah. CRNR: City of Rocks National Reserve; JS Mt: Jim Sage Mountain, BP Div. SNF: Black Pine Division-Sawtooth National Forest, RR Div. SNF: Raft River Division-Sawtooth National Forest.**

| | | ***Road / trail segments - GPS Coordinates*** | | | | ***Observational Plots*** | | | ***Reconnaissance Survey*** | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Area surveyed*** | ***Road Segments*** | ***Start*** | | ***End*** | | ***Number of plots*** | ***Number of Pinyon pines*** | ***Number of infected* trees*** | ***Length (miles)*** | ***Number of symptomatic* trees*** |
| | | ***Latitude*** | ***Longitude*** | ***Latitude*** | ***Longitude*** | | | | | |
| CRNR | E. City of Rocks Loop Rd (east) | 42.0837 | -113.6719 | 42.0791 | -113.6774 | 2 | n/a + | 0 | 0.5 | 0 |
| CRNR | Circle Creek Overlook Rd. | 42.0812 | -113.6753 | 42.0876 | -113.6852 | 5 | n/a + | 0 | 0.7 | 0 |
| CRNR | E. City of Rocks Loop Rd (west) | 42.0684 | -113.7088 | 42.0845 | -113.7259 | 8 | n/a + | 0 | 1.7 | 0 |
| CRNR | Smoky Mt. Campground | 42.0765 | -113.6518 | 42.0758 | -113.6526 | 7 | 55 | 0 | 0.7 | 0 |
| CRNR | California Trail | 42.0773 | -113.6225 | 42.0791 | -113.6728 | 7 | 116 | 0 | 1.2 | 0 |
| JS Mt. | Jim Sage Canyon Rd. | 42.1003 | -113.5192 | 42.1205 | -113.5093 | 7 | 68 | 0 | 1.6 | 0 |
| BP Div. SNF | Green Canyon Rd. (FS 028) | 42.0001 | -113.1592 | 42.0131 | -113.1605 | 3 | 23 | 0 | 1.0 | 0 |
| BP Div. SNF | Strevell Rd. (FS 027) | 42.0171 | -113.1573 | 42.0134 | -113.1669 | 3 | 11 | 0 | 0.6 | 0 |
| RR Div. SNF | One Mile Rd (FS 005) | 41.9716 | -113.4283 | 41.9664 | -113.4399 | 6 | 119 | 0 | 1.2 | 0 |
| RR Div. SNF | One Mile Rd (FS 005A) | 41.9609 | -113.4383 | 41.9545 | -113.4424 | 5 | 177 | 0 | 0.8 | 0 |
| RR Div. SNF | One Mile Rd (FS 005D) | 41.9480 | -113.4558 | 41.9380 | -113.4750 | 3 | 96 | 0 | 0.4 | 0 |
| RR Div. SNF | Cabin Spring Rd. (FS 011) | 41.9331 | -113.4758 | 41.9313 | -113.4675 | 4 | 149 | 0 | 1.0 | 0 |
| RR Div. SNF | Broad Hollow Rd (FS 016) | 41.9185 | -113.6932 | 41.9124 | -113.6955 | 9 | 203 | 0 | 1.6 | 0 |
| RR Div. SNF | Wild Cat Rd. (FS 003) | 41.9306 | -113.5999 | 41.9154 | -113.6056 | 6 | 117 | 0 | 1.2 | 0 |
| RR Div. SNF | Clear Creek Rd. (FS 001) | 41.9556 | -113.3108 | 41.9490 | -113.3496 | 11 | 228 | 0 | 2.2 | 0 |

*= Pinyon pine dwarf mistletoe and / or black stain root disease. += No tree tallied was performed.

Although no pinyon pine dwarf mistletoe or black stain root disease were found, we observed mature single-leaf pinyon pines with masses of pinkish-white pitch in the Smoky Mountain Campground and along the California trail (**Figure 3**). The injuries resulted on individual killed branches. Reasons for the recorded damages are unknown. Similar damages are known to be induced by pitch mass borer, *Dioryctria sp*. in Utah and Nevada on single-leaf pinyon pine (Skelly and Christopherson 2003; Keyes and U.S. Forest Service 2019) and pinyon blister rust, caused by the fungal pathogen *Cronartium occidentale* (Sinclair and Lyon 2005).

**Figure 3. Oozing masses of soft, light-pink sap on single-leaf pinyon pine branches in the Smoky Mountain campground and along the California trail, City of Rocks Natural Reserve.**

We did not observe single-leaf pinyon pine mortality in any of the surveyed areas. However, tree mortality has been observed within the City of Rock National Reserve area (Dr. J. McMillin, Forest Health Protection, Boise Field Office- personal communication, 2017). Due to time limitations, we did not make any attempts to identify those trees within the area and further investigate agent-caused mortality.

The results of these surveys appear to concur with the current knowledge regarding pinyon pine dwarf mistletoe distribution in western United States (Mathiasen et al. 2002). Based upon our results and literature reviews, populations located in the Pilot Mountain Range (Box Elder Co., Utah) remains the northernmost known population of pinyon pine dwarf mistletoe.

Frequency and intensity of wildfire play a role in the distribution of dwarf mistletoes (Zimmerman and Davis 1984). Depending on the size and frequency of wildfire, they may either inhibit or encourage the development of these pathogens. Prior to the establishment of forest reserves (Cassia, Raft River, Goose Creek, Black Pine, and Sublett) in early 1900's, forest fires were occasionally started by lighting, by European settlers or Native Americans and very little attention were paid to those fires, which may have burn for weeks. Since then, several fires have burned, natural or anthropogenic causes (settler activities or accidently set by campers) influencing forest composition (MNF History 1941). Covington and others (1994) stated that fires were intentionally set for a variety of other reasons, including increases of desired plant species, driving game animals, and clearing transportation routes. The lack of occurrence of pinyon pine dwarf mistletoe across the surveyed areas could be attributed, at least in part, to fire history. However, further investigation is needed to describe this potential relationship between fire occurrence and lack of pinyon pine dwarf mistletoe distribution in southern Idaho and northern Utah.

Forest Health Protection, Boise Field office is planning to continue searching for pinyon pine dwarf mistletoe in southern Idaho and northern Utah, especially to substantiate *Arceuthobium divaricatum* presence in Cassia County, Idaho as reported by J.R Weir in 1920 should. Scattered single-leaf pinyon pine populations located within its northern distribution: the Grouse Creek Mountain (east of Grouse Creek, Box Elder Co. UT), Crawford Mountains (Rich Co., Utah), Logan and Dry canyons (Cache Co. UT), Blacksmith Fork (Cache Co. UT), and north of Porcupine Reservoir (Cache Co. UT) (Erdman 1970; Lanner and Hutchinson 1972) among other areas should be included in future surveys. Estimates of basal area and tree diameters will also be considered to describe the openness of these pinyon stands (**Figure 4**).

In 2019, single-leaf pinyon pine decline and mortality has been reported occurring within the City of Rocks National Reserve (Wallace Keck, Park Superintended, personal communication). Indicators of any primary biotic agent or agent complex that could account for the damage observed has not been clearly defined. Consequently, Forest Health Protection, Boise Field Office began planning collaborating work in conjunction with the City of Rocks National Reserve in order to identify factors that could be contributing to the reported damage to this historical important from an ecological and socio-economic perspective tree species.

In summary, we surveyed 8 segments of forested roads/trail in southern Idaho and northern Utah. Single-leaf pinyon pine surveyed stands are not overly dense, composed of diverse age classes, and in good forest health conditions (**Figure 4**).

If you have any questions or comments regarding this report, or if you require any further information on the biology, management of forest insects and diseases, please contact us or the Boise Field Office, Carl Jorgensen at 208-373-4225.

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**Figure 4. Relatively open single-leaf pinyon pines along Clear Creek Rd (FS 001) in northern Utah at 6,329 feet, September 2018 (Geographic position of area: 41° 57' 15.372", -113° 19' 19.2").**

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